Socioeconomic Characteristics Are Major Contributors to Ethnic Differences in Health Status in Obstructive Lung Disease

An Analysis of the National Health and Nutrition Examination Survey 2007-2010

Carlos H. Martinez, MD, MPH; David M. Mannino, MD, FCCP; Jeffrey L. Curtis, MD; MeiLan K. Han, MD; and Alejandro A. Diaz, MD, MPH

BACKGROUND: Understanding ethnic differences in health status (HS) could help in designing culturally appropriate interventions. We hypothesized that racial and ethnic differences exist in HS between non-Hispanic whites and Mexican Americans with obstructive lung disease (OLD) and that these differences are mediated by socioeconomic factors.

METHODS: We analyzed 826 US adults aged ≥ 30 years self-identified as Mexican American or non-Hispanic white with spirometry-confirmed OLD ($FEV_1/FVC < 0.7$) who participated in the National Health and Nutrition Examination Survey 2007-2010. We assessed associations between Mexican American ethnicity and self-reported HS using logistic regression models adjusted for demographics, smoking status, number of comorbidities, limitations for work, and lung function and tested the contribution of education and health-care access to ethnic differences in HS.

RESULTS: Among Mexican Americans with OLD, worse (fair or poor) HS was more prevalent than among non-Hispanic whites (weighted percentage [SE], 46.6% [5.0] vs 15.2% [1.6]; $P < .001$). In bivariate analysis, socioeconomic characteristics were associated with lower odds of reporting poor HS (high school graduation: OR, 0.24 [95% CI, 0.10-0.40]; access to health care: OR, 0.50 [95% CI, 0.30-0.80]). In fully adjusted models, a strong association was found between Mexican American ethnicity (vs non-Hispanic white) and fair or poor HS (OR, 7.52; 95% CI, 4.43-12.78; $P < .001$). Higher education and access to health care contributed to lowering the Mexican American ethnicity odds of fair or poor HS by 47% and 16%, respectively, and together, they contributed 55% to reducing the differences in HS with non-Hispanic whites.

CONCLUSIONS: Mexican Americans with OLD report poorer overall HS than non-Hispanic whites, and education and access to health care are large contributors to the difference.

CHEST 2015; 148(1):151-158

Manuscript received July 22, 2014; revision accepted January 5, 2015; originally published Online First January 29, 2015.

ABBREVIATIONS: HR-QOL = health-related quality of life; HS = health status; NHANES = National Health and Nutrition Examination Survey; OLD = obstructive lung disease

AFFILIATIONS: From the Division of Pulmonary and Critical Care Medicine (Drs Martinez, Curtis, and Han), University of Michigan Health System, Ann Arbor, MI; Division of Pulmonary, Critical Care and Sleep Medicine (Dr Mannino), University of Kentucky College of Medicine, Lexington, KY; Department of Epidemiology, Preventive

Medicine and Environmental Health (Dr Mannino), University of Kentucky College of Public Health, Lexington, KY; VA Ann Arbor Healthcare System (Dr Curtis), Ann Arbor, MI; and Division of Pulmonary and Critical Care Medicine (Dr Diaz), Brigham and Women's Hospital, Harvard Medical School, Boston, MA.

Part of this article has been presented in abstract form at the 2014 International Conference of the American Thoracic Society, May 16-21, 2014, San Diego, CA.

FUNDING/SUPPORT: Dr Martinez is supported by funding from the National Institutes of Health (NIH) National Heart, Lung, and Blood

Obstructive lung disease (OLD), which includes COPD, imposes a significant burden on society¹ and the individual patient² in terms of symptoms, acute exacerbations, and mortality.^{2,3} Use of a patient-centered measure, the impact on health status (HS) and health-related quality of life (HR-QOL), demonstrates that OLD is associated at the population level with decrements in HS of similar or greater magnitude compared with the effect of cardiovascular disease or diabetes.⁴ Hence, a better understanding of racial and ethnic factors of OLD could have a highly significant effect on overall health care. Comparisons of racial differences in HR-QOL in patients who have experienced exacerbations of COPD showed worse HR-QOL in African Americans.⁵ However, minimal research has been done on differences in HR-QOL in other racial or ethnic groups with OLD.

Materials and Methods

Study Design

This study is a cross-sectional analysis of a nationally representative interview and examination health survey, NHANES. The NHANES methodology has been described elsewhere.¹² An expanded description of the methods is included in e-Appendix 1. The current analysis used data from NHANES 2007-2008 (response rates for interview and examination, 78% and 75%, respectively) and 2009-2010 (response rates, 79% and 77%, respectively). We included only participants aged 30 to 79 years who self-identified either as Mexican American (population of interest) or non-Hispanic white (comparison group). NHANES data are available in the public domain and deidentified, making the current investigation exempt from human subject review.

Selection Criteria

Participants in NHANES 2007-2008 and 2009-2010 (Mexican Americans and non-Hispanic whites aged 30-79 years) were included if they had spirometry-defined OLD based on modified GOLD (Global Initiative for Chronic Obstructive Lung Disease) criteria.¹³ Spirometry was obtained following American Thoracic Society recommendations.¹⁴ Participants were also required to have complete data on HS. We restricted the study population to Mexican Americans because they are the largest subgroup of Hispanics in the United States (up to 60%) and because of the limited sample size of other Hispanics in NHANES. We used non-Hispanic whites as the reference group because they are still reported as having an advantageous position in social, economic, and health-related indicators.¹⁵

Hispanics are the largest, youngest, and fastest growing ethnic minority in the United States, with Mexican Americans being the largest subgroup. Although there has been interest in understanding HR-QOL among Hispanics with various chronic diseases,⁶ less is known about the impact of COPD in this group of Americans.⁷ It is known that Mexican Americans with low education levels have poorer HR-QOL⁸ and that they have low rates of regular access to health care.⁹ Based on evidence of differences in QOL among African Americans with COPD and of the role of socioeconomic factors in explaining differences in HS in vulnerable groups,^{10,11} we hypothesize that differences exist in HR-QOL in Mexican American participants with OLD in the National Health and Nutrition Examination Survey (NHANES) and that socioeconomic disparities (education and access to health care) contribute to the differences in OLD-related HS.

Outcome: HS Measurements

The main outcome was overall self-rated HS based on the previously validated Centers for Disease Control and Prevention HR-QOL instrument.^{16,17} Participants were asked, "Would you say your health in general is...?" Response options ranged from excellent to poor and were recoded in a binary manner with the answers excellent, very good, and good as the reference and fair and poor as the outcome of interest.¹⁸

Covariates

We included the following covariates relevant to models of HR-QOL in OLD and to conceptual models of racial and ethnic differences in HR-QOL^{19,20}: age, sex, BMI, education level, and lifetime smoking status. We used the language spoken during the medical examination as a measure of acculturation.²¹ Access to health care²² and physical impairment were also evaluated. The presence and number of physician-diagnosed comorbidities (arthritis, cancer, chronic heart failure, heart attack, angina, coronary artery disease, osteoporosis, sleep disorder, and stroke) were based on positive responses to the question, "Have you ever been told by a doctor or other health-care professional that you had [condition name]?"¹⁸ Heart attack, angina, and coronary artery disease were combined into coronary disease. Information on presence of diabetes, hypertension, depression,²³ and obesity (BMI ≥ 30 kg/m²) was also obtained. The number of comorbidities for each participant were recoded as zero, one to two, or three or more of 11 possible comorbid conditions.

Statistical Analysis

Descriptive statistics with proportions or means were used when appropriate. Comparisons of racial and ethnic differences in the outcome were tested with the Rao-Scott modified χ^2 test. Logistic analyses were then used to assess the association between Mexican American ethnicity (with non-Hispanic whites as reference) and HS. Based on theoretical models of HS, we constructed an initial logistic model including all covariates considered factors that can confound or modify the aforementioned association (base model). In a second step, we assessed the extent to which common social disparities (education and access to health care) contribute to the effect of Mexican American ethnicity on HS by including one variable at a time to the basic model (adjusted model). To assess the extent of the contribution of these factors, we examined the change in OR after the inclusion of each variable or set of variables. Using this method,²⁴ a change in the OR toward the null hypothesis suggests a mediating effect of that variable on such association.^{24,25} The contribution of each factor

Institute (NHLBI) [Grant T32 HL007749-20]. Dr Han is supported by funding from NIH NHLBI [Grant K23 HL093351]. Dr Curtis is supported by funding from the Clinical Research and Development Service, Department of Veterans Affairs, and the US Public Health Service [Grant U01 HL098961]. Dr Diaz is supported by funding from NIH NHLBI [Grant K01 HL118714].

CORRESPONDENCE TO: Carlos H. Martinez, MD, MPH, Division of Pulmonary and Critical Care Medicine, University of Michigan Health System, 3916 Taubman Center, Box 0360, 1500 E Medical Center Dr, Ann Arbor, MI 48109-5360; e-mail: carlosma@umich.edu

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DOI: 10.1378/chest.14-1814

to the change in OR was calculated as follows: $[\text{OR}_{\text{base model}} - \text{OR}_{\text{adjusted model}} / (\text{OR}_{\text{base model}} - 1) \times 100]$. All analyses incorporated appropriate sampling weights to account for the complex study design, sampling,

and nonresponse and were performed using callable SUDAAN release 10.1 (RTI International) and SAS 9.3 (SAS Institute Inc) statistical software.

Results

NHANES 2007-2010 included 6,492 participants aged ≥ 30 years and self-designated as Mexican American or non-Hispanic white who participated in the Mobile Examination Center. Of these, 1,624 (25%) did not have a spirometric assessment performed (Fig 1). Participants with no spirometric evaluation were more likely to be older, female, and current smokers. These participants also had a lower education level, higher prevalence of self-reported COPD (chronic bronchitis or emphysema), and poorer overall HS but greater access to health care. No differences in the frequency of race/ethnicity and asthma were found (e-Table 1). Among the participants with missing spirometric data, Mexican Americans reported a poorer HS than did non-Hispanic whites ($53\% \pm 3.1\%$ vs $29\% \pm 1.4\%$; $P < .001$). Among the 4,856 participants with complete spirometric and height data, 871 (17.6% $\pm$ 0.8%) had OLD (Mexican Americans, 6.3% $\pm$ 0.7%; non-Hispanic whites, 18.9% $\pm$ 0.9%). No difference in the response rate on HS was found between the two populations (93% vs 95%, respectively, $P = .10$). Finally, we eliminated 45 participants who did not respond to the question on HS, resulting in a final sample size of 826 participants (99 Mexican Americans).

Analysis of demographics, socioeconomic, and comorbidities by ethnic group among those with OLD (Table 1) showed that Mexican Americans were significantly less likely to be women. There was a nonsignificant trend toward more never smokers among Mexican Ameri-

cans. There were no differences in age, BMI, lung function, physical impairment, or burden of comorbidities. Almost one-half of Mexican Americans spoke Spanish during the interview (vs none of non-Hispanic whites). Mexican Americans more frequently reported fair or poor HS (weighted percentage, 46.6% vs 15.2% for non-Hispanic whites), had a lower education level, and reported less access to health care (Fig 2).

The associations between each predictor or set of predictors and HS are shown in Table 2, stratified by ethnicity and race. (To provide an additional comparison group, Table 2 also includes information about predictors of HS among African Americans, although they were not included in further analyses.) The results show that for all ethnic groups, a similar pattern of associations between the variables tested (higher lung function, higher education level, and access to health care) and HS were associated with lower odds of poor HS. Conversely, more comorbidities, physical impairment, and current smoking status increased the odds of fair or poor HS.

We next performed a step-by-step analysis of the contribution of educational achievement and access to health care in the association between Mexican American ethnicity and HS in logistic models (Table 3). The base model shows that the association between Mexican American ethnicity and poor HS was strong (OR, 7.52; 95% CI, 4.43-12.78). The contribution of high education level (high school graduate and beyond) to this association was 47% (OR, 4.44; 95% CI, 2.67-7.38). The contribution of both high education level and access to health care was 55% (OR, 3.91; 95% CI, 2.33-6.56). No other variables tested, including language used during the interview, contributed in a similar extent to the differences in HS. The results were similar when the outcome measure (HS) was used not as a dichotomous variable but, rather, as a nominal outcome based on ordinal regression (data not shown).

Discussion

This analysis of a nationally representative sample of adults with OLD shows that Mexican American respondents report a more severe impact of OLD on HS than non-Hispanic whites, regardless of lung function, and that the major contributors to the differences are socioeconomic disparities (educational achievement and access

Figure 1 – Flow of participants in NHANES 2007-2008 and 2009-2010. MEC = Mobile Examination Center; NHANES = National Health and Nutrition Examination Survey; OLD = obstructive lung disease.

TABLE 1 Baseline Characteristics of Participants Aged ≥ 30 Year With Obstructive Lung Disease by Race/Ethnicity

Characteristic	Non-Hispanic White (n = 727)	Mexican American (n = 99)	P Value
Female sex	41.8 (1.9)	26.0 (5.1)	.02
Age, y	57.5 $\pm$ 0.6	55.6 $\pm$ 1.7	.30
BMI, kg/m ²	27.4 $\pm$ 0.2	28.3 $\pm$ 0.6	.18
Spanish language at interview, yes	0	48.2 (6.1)	...
English language at interview, yes	100	51.8 (6.1)	...
Smoking status			.059
Never	29.0 (2.5)	43.8 (5.5)	
Former	37.0 (2.0)	30.5 (5.3)	
Current	34.1 (2.7)	25.6 (5.0)	
Self-reported asthma, yes	15.3	20.0	.22
No. comorbidities			.24
0	27.1 (2.2)	37.2 (6.8)	
1-2	49.6 (2.2)	41.0 (5.6)	
3	23.3 (1.7)	21.7 (5.1)	
Physical impairment, yes	21.2 (2.0)	14.0 (3.8)	.052
FEV ₁ , mL	2,641.0 $\pm$ 40.4	2,671.8 $\pm$ 119.7	.81
FEV ₁ , % predicted	81.2 $\pm$ 0.84	84.6 $\pm$ 2.1	.13

Data are presented as % (SE) for categorical variables or mean $\pm$ SD for continuous variables. Appropriate-weight variables were used. Missing data: 1 participant without BMI data. (Data from the National Health and Nutrition Examination Survey [cycles 2007-2008 and 2009-2010], National Center for Health Statistics.)

to health care). Formal and informal education is required for the complex tasks imposed by active participation and self-care in OLD and is one of the more robust factors associated with personal and family income in the United States. Access to care is one of the transition points in the natural history of any chronic disease and is an opportunity to reduce the health and economic burden of disease. Although education and

access to health care are not directly amendable by the individual clinician, they need to be considered when delivering treatment recommendations and management plans to the individual patient.

Compared with non-Hispanic whites, poorer HR-QOL has been described for Mexican Americans with other diseases,^{6,26} including self-reported asthma (a component of OLD).²⁷ We extend the evidence by demonstrating similar associations in subjects with spirometry-confirmed OLD based on nationally representative data. Prior research has shown that compared with non-Hispanic whites, Mexican Americans have a lower odds of receiving a diagnosis of OLD but no differences in mortality²²; less is known about the impact of OLD on HS. When HS was tested in the whole population with OLD, the associations with well-known factors, such as education, age, comorbidity burden, and emotional symptoms, were confirmed in agreement with the predictions based on general models of HR-QOL in national samples of subjects with self-reported COPD or asthma (components of OLD).^{18,28} We extend those findings by showing that Mexican American ethnicity is associated with poorer HS (OR, 2.21; 95% CI, 1.16-4.21), similar to what has been found in coronary heart disease (Hispanic ethnicity associated with fair or poor health: OR, 1.5; 95% CI, 1.2-1.9)²⁶ and the metabolic syndrome (Mexican

Figure 2 – Differences in education level, access to health care, and overall health status between non-Hispanic whites and Mexican Americans. Data represent weighted percentages. (Data are from the National Health and Nutrition Examination Survey [cycles 2007-2008 and 2009-2010], National Center for Health Statistics.)

TABLE 2] Bivariate Association With Health Status (Fair or Poor) for Adults Aged ≥ 30 Year With Obstructive Lung Disease

Characteristic	Non-Hispanic White	Mexican American	African American
Sex			
Male	Reference	Reference	Reference
Female	1.2 (0.9-1.7)	0.6 (0.3-1.5)	2.06 (0.95-4.46)
Age (per year increment)	1.01 (1.00-1.03)	1.01 (0.98-1.03)	1.00 (0.98-1.03)
FEV ₁ (per 100-mL increment)	0.94 (0.91-0.97)	0.98 (0.93-1.04)	0.93 (0.89-0.97)
BMI			
≤ 24.9 kg/m ²	Reference	Reference	Reference
25.0-29.9 kg/m ²	0.91 (0.53-1.53)	1.39 (0.49-3.94)	2.03 (1.05-3.93)
≥ 30.0 kg/m ²	1.56 (1.02-2.39)	4.18 (1.36-12.86)	1.50 (0.80-2.81)
Education			
<High school graduate	Reference	Reference	Reference
$\geq$ High school graduate	0.28 (0.1-0.5)	0.1 (0.1-0.3)	0.2 (0.1-0.4)
Access to health care			
No	Reference	Reference	Reference
Yes	0.63 (0.4-1.0)	0.63 (0.2-2.3)	1.6 (0.9-3.1)
Language used at interview			
English	N/A	Reference	Reference
Spanish	N/A	0.4 (0.1-1.0)	N/A
Smoking status			
Never	Reference	Reference	Reference
Former	2.9 (1.5-5.4)	0.9 (0.2-3.8)	1.6 (0.9-2.8)
Current	1.8 (1.0-3.3)	0.4 (0.1-1.3)	1.6 (0.7-3.5)
No. comorbidities			
0	Reference	Reference	Reference
1-2	1.4 (0.9-2.3)	2.2 (0.9-5.8)	0.8 (0.4-1.8)
3	4.0 (2.3-7.1)	3.1 (1.1-8.9)	1.2 (0.5-2.9)
Physical impairment			
No	Reference	Reference	Reference
Yes	6.8 (4.6-10.1)	4.5 (1.4-13.9)	2.7 (1.4-5.4)

Data are presented as OR (95% CI). Appropriate-weight variables were used. N/A = not applicable. (Data from the National Health and Nutrition Examination Survey [cycles 2007-2008 and 2009-2010], National Center for Health Statistics.)

American ethnicity increased the odds of poor overall health by 3.38).⁶

The differences in HS are interesting and occur despite a similar pattern of associations between predictors (education, age, comorbidity burden, and emotional symptoms) and HS in different ethnic groups. These findings illustrate the complexity of the ethnic differences in disease impact in OLD, which are present not just between non-Hispanic whites and Mexican Americans but also between non-Hispanic whites and African Americans because it has been proven by other researchers. For example, in analyses comparing non-Hispanic whites and African Americans with COPD in the COPDGene

(Genetic Epidemiology of COPD) cohort, Han et al⁵ found similar HR-QOL in the absence of exacerbations but worse HR-QOL for African Americans who had experienced exacerbations. In the present analyses, we tried to advance the current knowledge to identify possible casual pathways of poorer HS in Mexican Americans with OLD. We used analyses comparing the contribution of several variables to the differences, testing whether the effect of ethnicity (exposure) on HS (outcome) occurs through the action of other variables that change the strength of the exposure-outcome association when absent or present in the analytical model. This type of analysis explores potential casual pathways

TABLE 3] Contribution of Education and Access to Health Care to the Association Between Mexican American Ethnicity and Health Status

Model	Mexican American, OR (95% CI)	Contribution to the Association, %
Base model	7.52 (4.43-12.78)	...
Base model + high education level	4.44 (2.67-7.38)	47
Base model + access to health care	6.45 (3.76-11.06)	16
Base model + high education level + access to health care	3.91 (2.33-6.56)	55

The base model included age (in y), female sex (yes/no), BMI (continuous), lifetime smoking status (never, current, former), number of comorbidities (0, 1-2, ≥ 3), physical impairment (yes/no), and FEV₁ (per 100-mL increase) as covariates.

in the presence of complex relations.^{24,25} We found that socioeconomic differences are the principal contributor to the association, extending what has been proven for Hispanics with metabolic syndrome⁶ and in studies of Mexican Americans living in *colonias* on the Texas-Mexico border reporting that poorer HR-QOL is associated with lower education.⁸

We explored the role of other factors potentially related to ethnic differences on HS, and none proved to have the same consistent and strong associations. For example, instruments and questionnaires to evaluate HR-QOL and HS could be subject to differences in interpretation due to cultural values and English-language proficiency among diverse populations and minorities or to the effect of acculturation.²¹ Language use (English) is an adjustment required for successful adaptation and reduction of acculturative stress.²¹ However, lack of impact of acculturation on HR-QOL in other respiratory diseases (eg, sleep disorders) has been reported by Soler et al²⁹ in a population-based survey comparing sleep quality between Mexican Americans and non-Hispanic whites, and we found similar associations. Finally, based on interest in the association of comorbidities with poorer HR-QOL in COPD,^{18,30} we also tested this variable as a significant contributor to the ethnic differences, with negative results. Thus, after extensive analyses, only socioeconomic disparities were major contributors to the ethnic differences in HS in OLD.

Findings similar to those of the present study are in the opposite direction of predictions of better health out-

comes in Hispanics than in whites, despite socioeconomic differences, based on the “Hispanic paradox.”³¹ The current findings add to our previous report contradicting the expected advantage conferred by being Mexican American²² and provide evidence on the lack of benefits of Hispanic ethnicity to the field of HR-QOL. Of particular interest is that participants with OLD in NHANES 2007-2010 are, on average, relatively young (mean age, around 56 years), whereas the frequency and impact of OLD increases with aging. If, as shown in other population groups, differences in QOL between non-Hispanic whites and other minorities worsen as the age of the population increases (known as the double jeopardy theory),³² the ethnic differences in HS between Mexican Americans and non-Hispanic whites could be expected to grow and should be a target for interventions earlier in life.

Some strengths of the present study include the use of spirometry to define OLD and the use of representative samples of the population, providing us with the ability to extrapolate the results to the national level. The analysis also has some limitations. First, 25% of the participants in the Mobile Examination Center did not undergo spirometric assessment, which may bias the estimates; however, we found no racial or ethnic differences in the proportion of participants with and without missing data. Furthermore, among those with missing data, Mexican Americans reported poorer HS than did whites, substantiating the results. The findings should not be extrapolated to other Hispanic populations (we restricted the analyses to Mexican Americans) or to diseases other than OLD. Additionally, although we present evidence about differences in HS between African Americans and non-Hispanic whites, this was not the focus of the current analysis and needs to be explored in more detail. Second, we used a generic measure of HS, not a disease-specific HR-QOL instrument, but this outcome measure has been validated in various studies, has been used in similar investigations of subgroups with OLD, and is suitable for population-based studies.³³ Because this is a self-reported assessment of HR-QOL, misclassification is possible, but we suspect that differential misclassification by group is unlikely. Third, the sample size was small because it was restricted to participants with a spirometry-confirmed obstructive airway defect, but our measures of effect are robust and of the same magnitude as other studies. Finally, we discovered the magnitude and factors associated with the differences in HS between Mexican Americans and non-Hispanic whites, but future

interventions based on the present findings are still to be developed.

Conclusions

We demonstrate that the impact of OLD in Mexican Americans, as measured by the impact on global HS, is significant and more severe than in non-Hispanic

whites and that the differences are explained mainly by socioeconomic disparities (access to health care and education). Although these variables are preventable and modifiable only by population-based interventions, they have to be taken into consideration by the clinician, particularly when engaging the patient in complex treatments and self-care plans.

Acknowledgments

Author contributions: A. A. D. had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. C. H. M., D. M. M., J. L. C., M. K. H., and A. A. D. contributed to the study concept, data analysis, clinical interpretation of the data, writing of the manuscript, and approval of the final draft of the manuscript.

Financial/nonfinancial disclosures: The authors have reported to *CHEST* the following conflicts of interest: Dr Mannino has received honoraria or consulting fees and served on speaker bureaus for GlaxoSmithKline plc; Novartis AG; Pfizer Inc; Boehringer Ingelheim GmbH; AstraZeneca; Forest Laboratories, Inc; Merck Sharp & Dohme Corp; Amgen Inc; and Creative Educational Concepts. He has received royalties from UpToDate, Inc, and is on the board of directors of the COPD Foundation. Dr Han participated in advisory boards for Boehringer Ingelheim GmbH and GlaxoSmithKline plc; participated on speaker's bureaus for Boehringer Ingelheim GmbH, GlaxoSmithKline plc, Grifols, and Forest Laboratories, Inc; has consulted for United Biosource Corporation; and has received royalties from UpToDate, Inc. Drs Martinez, Curtis, and Diaz have reported that no potential conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

Role of sponsors: The sponsors did not participate in the design, analysis, writing, or approval of the manuscript.

Other contributions: This work was performed at the University of Michigan Health System and Harvard University.

Additional information: The e-Appendix and e-Table can be found in the Supplemental Materials section of the online article.

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